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Heavy Losses in Air Seasoning Georgia Pine and how to reduce them

by

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More southern pine lumber is produced in Georgia than in any other state in the nation. In 1953, nearly 2 billion board-feet were cut, representing a wholesale value of more than 150 million dollars. In addition, the total value of the lumber industries' contribution to the economy of the state is increased several times by remanufacturing operations and marketing processes. Hence, handling and seasoning methods affecting the value of the lumber are vital matters.

Only a small percentage of this 2 billion feet of pine lumber is kiln-dried. Most of it is air seasoned. This study indicates that losses by seasoning-degrade from the green to the dry state range from $5.21 per thousand board-feet for package piled lumber to as much as $26.21 per thousand board-feet for flat piled lumber. This means that for every million feet of lumber air seasoned, the average Georgia yard may suffer a potential loss in income of from $5,000 to $26,000. The average loss suffered from all seasoning-degrade by four methods of stacking involved in this study was $10.21 per thousand board-feet, or $10,000 per million board-feet.

Even more serious than this monetary loss is the competitive market situation developing with regard to southern pine lumber. Because much of this lumber has been placed on the market at too high a moisture content, with excessive stain, and containing noticeable warp, other wood species, metals, and synthetics have made marked inroads into the southern pine market. Several large Georgia lumber companies and numerous small ones have been forced to close during the past year. Had the demand been consistently strong and had additional revenue been realized from better seasoning practices, these concerns might have been able to survive the steadily rising cost of labor and stumpage.

Southern pine lumber is still unsurpassed for construction. It can, however, be sold at a premium only if the quality of the finished product is maintained at a high level. To do this means that it must be properly seasoned. An estimated 80-percent reduction of dollar losses from air seasoning is possible with simple, well known remedial measures and usually without a large outlay of money for additional equipment.

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Studies of air seasoning lumber have been made on several occasions (1, 2, 3, 4, 5, 6, 7). There are, however, no published research data on the different methods of stacking used in Georgia, nor has any determination of value losses from these methods been made. This study of air seasoning lumber in Georgia was made to determine the principal causes of seasoning-degrade, the extent of losses from current seasoning practices, and how these losses can be prevented.

DETAILS OF THE STUDY

Twenty yards throughout the state were visited for general information and a detailed study was made of one or more typical lumber piles at 18 of these yards (fig. 1). Owners and operators assisted materially by supplying information and by furnishing labor to tear down the stacks involved. Various sizes and kinds of yards were selected in an effort to obtain a representative cross-section (table 1).

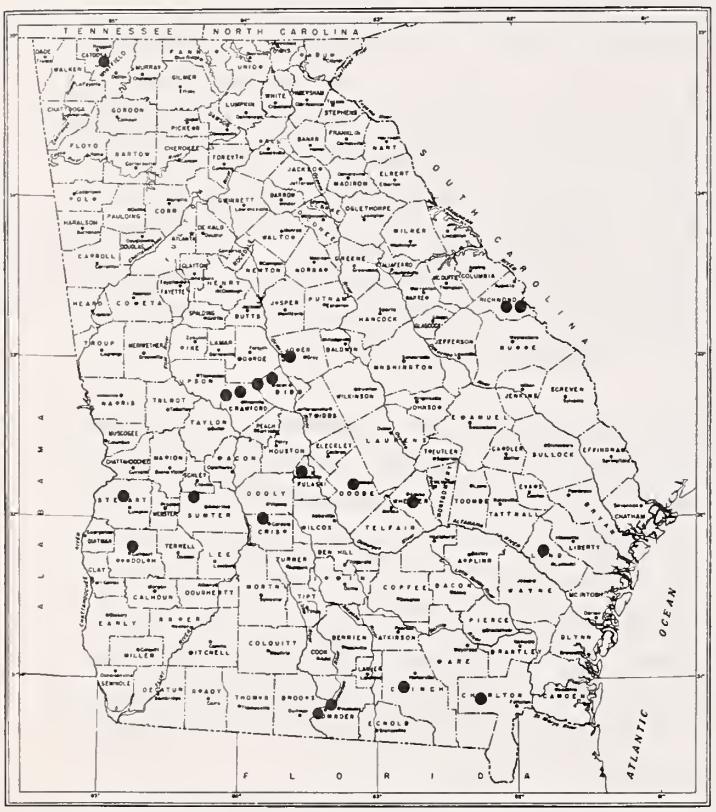

Figure 1.--Location of yards used in air seasoning study.

Thirteen factors which contributed to slow drying and degrade were used in rating the efficiency of these yards. They are summarized in table 2 and include yard surface, sanitation, drainage, aeration, foundation height and construction, stack covers, stack spacing, uniformity and alignment of stickers and bolsters, and the use of antistain chemicals. If no more than 3 of these conditions existed at a yard, it was rated "good," if from 4 to 6 "fair," and if more than 6 "poor." On this basis, 2 of the 20 yards involved were good, 12 fair, and 6 poor.

Detailed information was obtained from selected stacks of lumber to determine the extent of loss during air drying, and the specific factors causing this loss, as well as to gain a knowledge of the relative uniformity of drying brought about by various methods of stacking. This intensive study was made of 4/4 pine stacked to dry by four methods commonly used in Georgia. Definitions of stacking methods differ. For Georgia, however, the following pile descriptions are generally accepted by the wood-using industry:

Table 1.--Sizes and kinds of yards visited

Size class, and volume seasoned annually (Board-feet)	Wholesale only	Retail only	Wholesale and retail
	Number	Number	Number
Less than 3 million	2	1	0
3 to 6 million	1	1	2
6 to 9 million	3	0	2
9 million and over	7	0	1
Total	13	2	5

Table 2.--Factors contributing to slow drying and degrade at 20 air drying yards throughout Georgia

	Yards	Proportion
	Number	Percent
Weeds and debris in roadways and alleys and around piles	13	65
Yard sites poorly drained	3	15
Yards poorly aerated because of location or obstructions	2	10
Yard surfaces so rough as to constitute a hazard when operating lumber-handling equipment	3	15
Foundations too low for efficient air circulation	11	55
Foundations improperly constructed for efficient air circulation	7	35
No stack covers	15	75
Distance between stacks insufficient to permit rapid drying	7	35
Stack construction so poor as to constitute a hazard or appreciably retard drying	2	10
Stickers unsized	6	30
Stickers unaligned or in wavy alignment	12	60
Foundation timbers and bolsters separating packages unaligned with stickers	6	30
Lumber not dipped in antistain solution before stacking	13	65

"Flat piled" most nearly conforms to the old method of hand stacking lumber by flat piling in 8-foot or wider piles, and piles so made are usually found on hand-operated yards. They may or may not be sloped, pitched, or covered, and are usually set on some kind of foundation so that the bottom courses are not in contact with the ground (fig. 2).

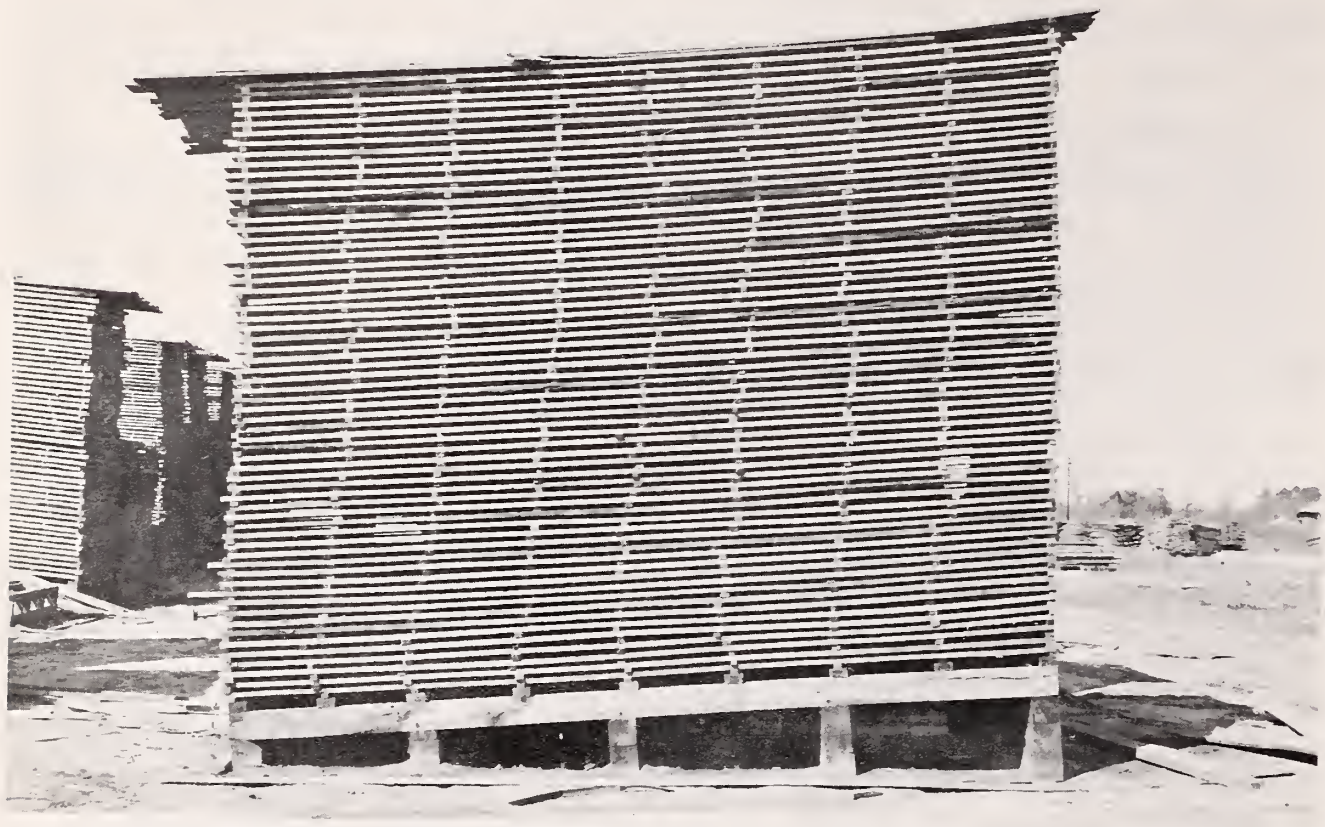

Figure 2.--A well constructed flat pile in south Georgia. Foundation timbers are made of treated material and the covers are sun- and rain-tight.

"Package piled" lumber is put up in unit packages for convenience of handling. These packages are usually 8 feet or less in width and are often made to conform to the dimensions of kiln trucks on those yards that kiln dry their better or special grades. A package pile normally consists of several unit packages separated by members called bolsters. These packages, transported by forklift trucks or similar devices, are a necessary part of yard mechanization (fig. 3).

"End piled" lumber refers to lumber stacked on end in a series of parallel courses. Lumber stacked in this manner might best be described as a flat pile stood on end. In many of the larger yards, lumber is end piled in stacks containing 25 M board-feet or more, since the length of the pile is limited only by available yard space (fig. 4).

"Crib piled" lumber is stacked by means of flat piling in a 3-sided pen or crib. A crib whose sides consist of a single tier of boards is single cribbed, of 2 boards is double cribbed, and of 3 boards is triple cribbed (fig. 5).

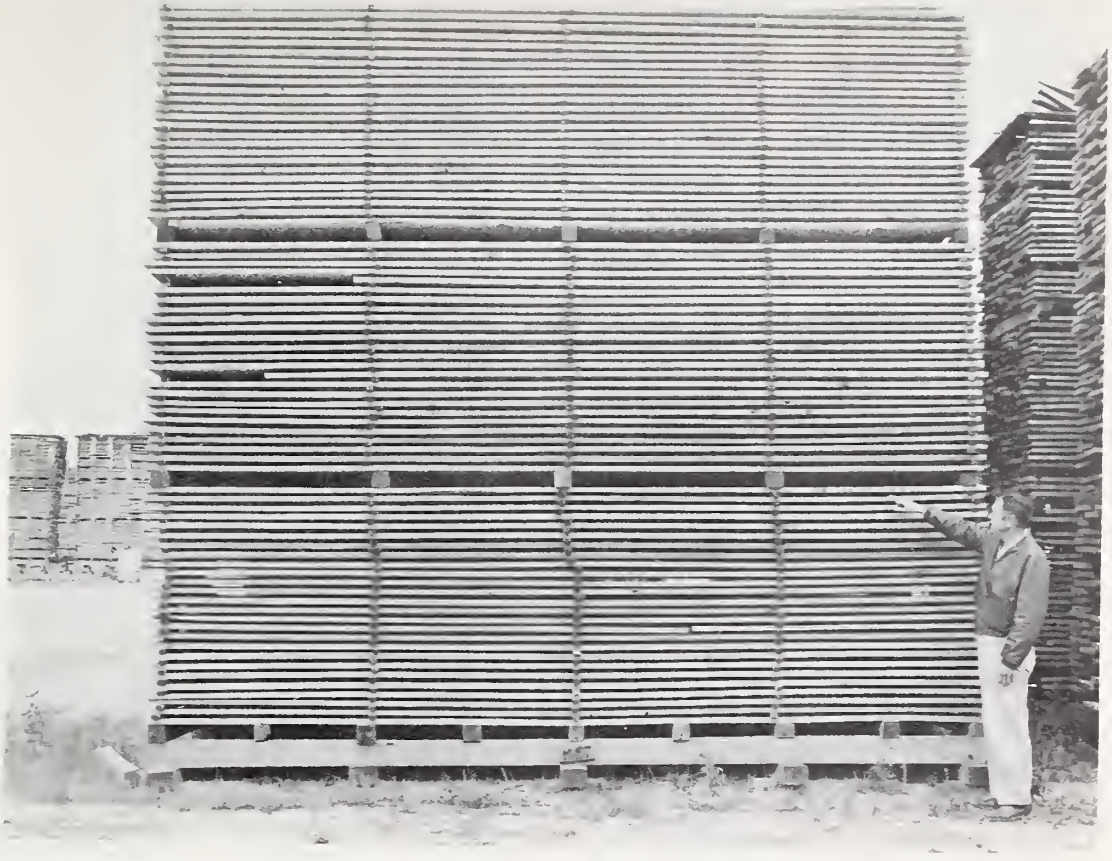

Figure 3.--Package piled pine in east Georgia. Both stickers and bolsters are well aligned to prevent excessive warping.

Figure 4.--In lumber dried by end piling, the board ends nearest the ground usually contain the most moisture and the top ends the least.

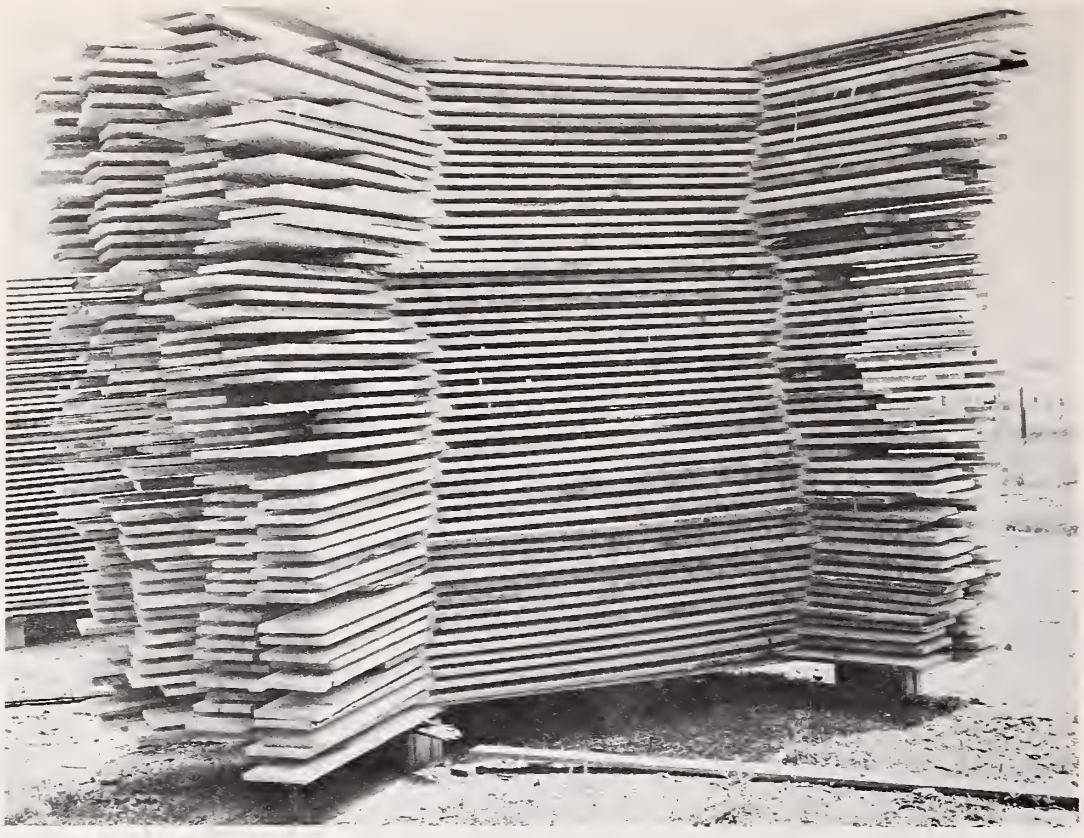

Figure 5.--Crib piled lumber dries rapidly except at the laps, but tends to warp because the boards are unsupported at the ends and centers.

The trend in air seasoning seems to be away from the flat pile, and, to a lesser extent, from the crib and end pile to the unit package pile. Perhaps the major factor responsible for this trend towards mechanization is the steadily rising cost of labor. One forklift truck will replace several yard hands and the whole operation of stacking, moving, and unstacking lumber is expedited by lumber-handling equipment. It seems reasonable to assume that in the next decade most of the concentration yards annually handling 5 million feet or more of lumber will be mechanized.

Lumber stacks selected for sampling had been drying from 19 to 172 days and all were considered air dry and ready to ship by the yard operators. Most of the lumber in individual piles was of uniform widths and lengths. Dimensions of lumber in different stacks ranged from 12 to 16 feet in length and from 4 to 12 inches in width.

The flat, package, and crib piles were sampled at different levels in the stack. All lumber contained in the three top courses was designated the top section, all lumber in the two bottom courses the bottom section, and two randomly selected boards from every other course between the top and bottom section the middle section. In end piles, 1 or 2 sample boards, depending on the size of the stack, were randomly selected from every course of the first 40 courses.

Each sample board was assigned two grades, one as if it contained no seasoning defects and one as it actually was. Southern Pine Inspection Bureau lumber grading rules for 1956 were followed in determining grades

and in describing defects. Moisture content determinations were made at a point 6 inches from one end and at the center of each sample board in the flat, package, and crib piles. An additional reading was taken from each board in the end piles, providing a top, middle, and bottom reading. A resistance-type moisture meter was used for this purpose. The grade, lumber tally, moisture content, and kind and amount of defects were recorded. Of a total of more than 40 M feet of lumber inspected, almost 8,500 feet was intensively studied (table 3).

Table 3.--A summary of volumes sampled by species and methods of piling

Method of piling	Stacks	Volume in samples	Volume in stacks	Ratio of sample volume to pile volume
	Number	Board-feet	Board-feet	Percent
Flat piled	4	2,252	8,998	25.0
Package piled	7	3,147	18,093	17.4
End piled	3	764	5,880	13.0
Crib piled	7	2,328	8,593	27.1
All methods	21	8,491	41,564	24.0

ANALYZING THE DATA

This report deals with averages, and not with individual board variations. A dollar value with and without air seasoning defects was assigned to each sample board on a basis of the board-foot content, grade, and current market value. The averages of these values were weighted according to volumes involved in the samples and sample stacks. The loss for each factor and by each method of piling was determined by subtracting the value of the boards before and after degrade. Seventy-eight dollars per thousand board-feet, the average wholesale price of No. 2 common air dried pine lumber in the Macon, Georgia, area at the time of the study, was used as a basis for these values. Values of other grades were then determined by using indices found in "Interim Log Grades for Southern Pine." [1/]

The moisture content of the sample piles was analyzed to determine what influence different methods of stacking had on drying times and uniformity of drying of the lumber involved in this study.[2/]

1/ An 18-page publication issued jointly in 1953 by the Southeastern Forest Experiment Station, the Southern Forest Experiment Station, Region 8, and the Forest Products Laboratory, Forest Service, U. S. Dept. Agr.

2/ Roy M. Carter and Rufus H. Page. Variation in moisture content of air seasoned southern pine lumber in Georgia. Publication pending in 1957 Forest Prod. Res. Soc. Proc.

In any analysis of loss by degrade and also of drying time and uniformity of drying, it is necessary to recognize that weather conditions play an important part in lumber drying and hence in the amount and kind of degrade, no matter how lumber is stacked. More rapid drying occurs when temperatures are high, relative humidities low, and when there is a rapid circulation of air. In the southeast, these factors are usually most favorable in the spring. As summer progresses, humidities as well as temperatures increase, and the winds subside somewhat. Conditions favorable to rapid drying, however, generally continue on into fall. Drying is slowed appreciably during cold, wet weather, and if air dried lumber is left on the yard during such periods, it will often pick up moisture. Lumber involved in this study was stacked in the spring and early summer of 1956. Daily weather records for 1955 and 1956 show that conditions for drying lumber were generally favorable for rapid drying during this time (fig. 6). In periods less favorable to rapid drying, more degrade, particularly from bluestain and decay, might be expected.

The relatively excellent drying conditions that preceded this study provided surprising results in the speed of drying and uniformity of moisture content. Practically all lumber that had dried 3 weeks or more, regardless of the method of stacking, showed an average moisture content below the 19 percent required by the Southern Pine Inspection Bureau. Individual moisture contents were sometimes high even though the average of the various layers in each type of piling indicated uniformity within the piles (table 4).

Although the data presented in table 4 show average moisture contents below 19 percent, it should not be assumed that all methods give equally satisfactory results. There is considerable variation in different boards in a lumber pile and even between different measurements within single boards. Generally speaking, such variations were least in flat and package piling and greatest in crib and end piling.

Table 4.--Average moisture content by methods of piling and position in pile

Method of piling	Range of seasoning periods	Position in pile 1/			Average for pile
		Top	Middle	Bottom	
	Days	- - - - Percent moisture content - - - -			
Flat piled	33-155	11.66	13.71	15.08	13.64
Package piled	31-104	15.50	15.57	16.14	15.48
End piled	19-36	15.10	16.49	19.15	16.91
Crib piled 2/	20-172	13.43	14.29	15.19	14.29

1/ Average measurement of top 2 layers, center layers, and bottom layers for all methods except end piling, where measurements were made in top, center, and bottom of individual boards.

2/ All measurement made away from laps. Moisture content at laps averaged 33.6 percent. Including laps, average moisture content was 16.58.

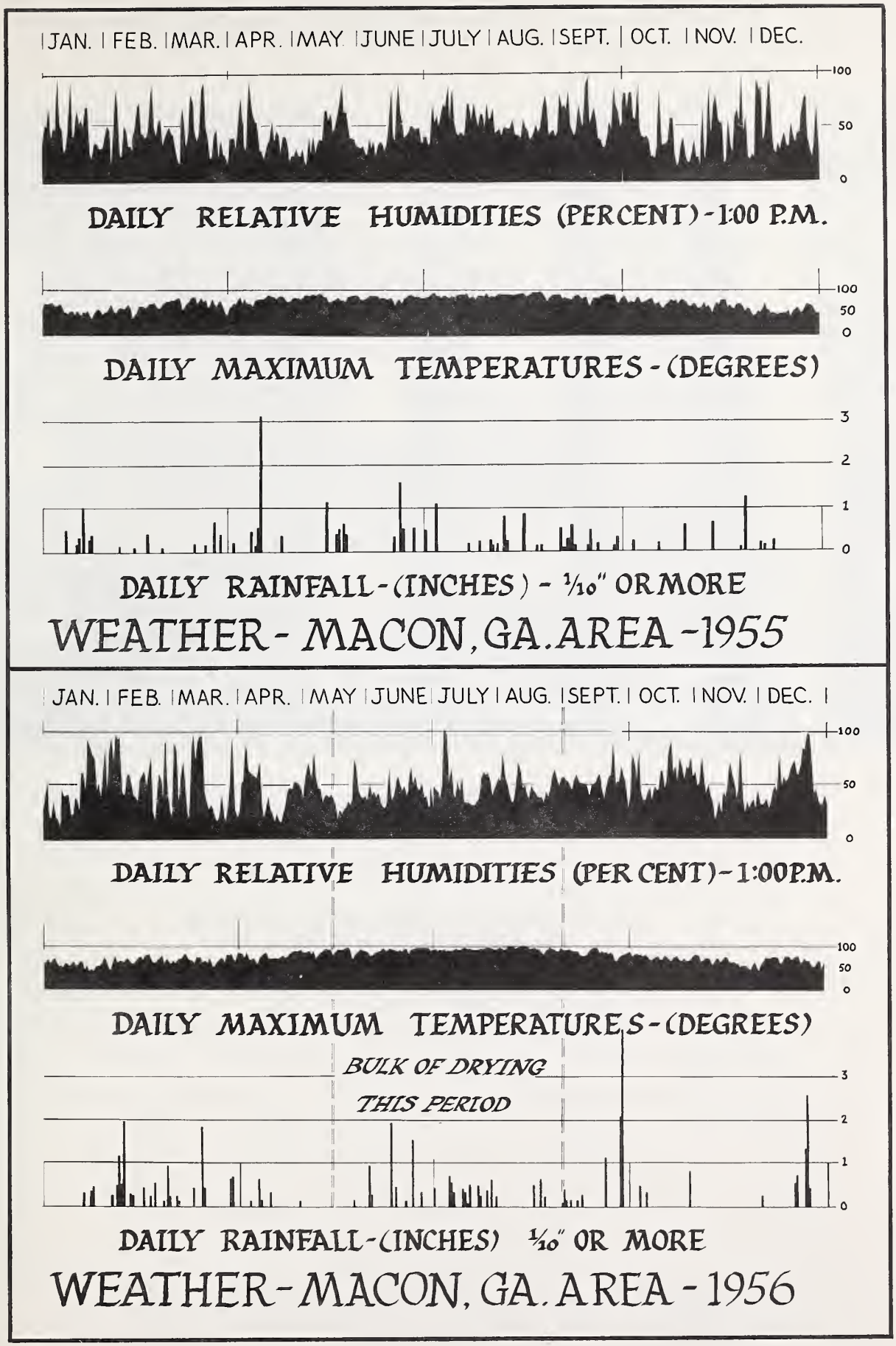

Figure 6.--Relative humidities, temperatures, and rainfall, Macon, Georgia, area, January 1, 1955-December 31, 1956, from Local Climatological Data, U. S. Dept. Com., Weather Bureau, Macon, Ga.

Stain (fig. 7) was by far the most important degrading factor encountered in this study. It comprised almost 85 percent of the total loss in flat piled lumber, 75 percent in end piled, 72 percent in package piled, and 35 percent in crib piled (table 5).

Figure 7.--Bluestain occurring where boards lapped in crib piling. Much of the lumber on this middle Georgia yard was degraded by bluestain.

Table 5.--Loss per thousand board-feet from various causes by four methods of stacking
(In dollars)

Cause	Package piled	End piled	Crib piled	Flat piled	Average all methods
Surface checks	0.31	0.33	0.47	--	0.31
End checks	.09	--	.03	0.31	.05
Stain	3.78	6.83	3.88	22.25	7.46
Decay	.02	--	3.74	--	.35
Crook	.10	.88	.42	.60	.77
Bow	.10	.20	1.22	1.01	.35
Cup	.12	.20	.08	.05	.03
Multiple defects 1/	.12	.90	1.33	1.99	.89
Total all causes	5.21	9.14	11.17	26.21	10.21

1/ Combinations of the above. A board may show stain, crook, and cup, which are impossible to separate on a dollar basis, and so they are lumped here.

The warping defects, crooks, bow, and cup, represent the next most important class of defects and account for an average loss of $1.35 per M board-feet in the samples studied. Twist, a fourth warping defect, occurred to a limited extent in the lumber sampled, but was not sufficiently severe to cause degrade.

Decay was important only in crib piled lumber and occurred where the boards lapped. As indicated by the moisture content of the lapped areas, drying below the fiber saturation point (30 percent) did not occur at most of these lap joints, and if pile stayed up long enough, decay fungi became active.

Checking was relatively unimportant with reference to degrade. It seems that unusually severe drying conditions are necessary to produce degrading checks in southern pine lumber.

Even in flat piles, package piles, and crib piles, where top, center, and bottom section can be delineated, it is difficult to evaluate losses by pile sections with any degree of consistency (table 6). This study, then indicates that for 4/4 pine, the section of the pile in which the lumber was stacked is of little importance in the over-all picture of air seasoning degrade. Since the study was made during a period of very favorable seasoning weather, this statement might not be true if the same lumber had been seasoned at a time when humidities were excessively high and rainfall more abundant.

Table 6.--Loss per thousand board-feet from various causes of degrade, by pile sections
(In dollars)

Cause	Flat pile				Package pile				Crib pile			
	Top	Middle	Bottom	Pile	Top	Middle	Bottom	Pile	Top	Middle	Bottom	Pile
Surface checks	--	--	--	--	1.24	0.20	2.31	0.31	--	0.45	1.42	0.47
End checks	1.05	0.23	--	0.31	.10	.09	--	.09	0.28	--	.37	.03
Stain	16.83	23.00	19.45	22.25	6.63	3.68	2.25	3.78	3.47	3.75	7.56	3.88
Decay	--	--	--	--	--	--	.63	.02	2.50	3.72	5.86	3.74
Crook	--	.70	--	.60	1.07	.66	--	.67	--	.47	--	.42
Bow	.69	1.09	--	1.01	.39	--	3.12	.10	6.43	.98	--	1.22
Cup	.46	--	--	.05	.09	.12	--	.12	--	.09	--	.08
Multiple defects	2.51	2.02	--	1.99	1.99	--	1.00	.12	6.15	1.12	--	1.33
All causes	21.54	27.04	19.45	26.21	11.51	4.75	9.31	5.21	18.83	10.58	15.21	11.17

RECOMMENDATIONS

Reduction of Bluestain

Although stain caused by fungi is the most serious degrading factor in pine air seasoning yards in Georgia, it is the easiest to eliminate. Stain fungi are active in pine lumber under warm, humid conditions when the moisture content of lumber is above 20 percent. Stain can be eliminated by reducing the moisture content on board surfaces below 20 percent immediately after it is sawn, or by dipping the fresh-sawn lumber in an antistain chemical.

Rapid air drying is the method most commonly tried and usually the most unsatisfactory. Crib piling, end piling and other methods of relatively open stacking are primarily to expedite drying. These methods fail in humid weather or where other factors such as lapped boards, close-piled lumber, inadequate foundations (fig. 8), or weeds and debris (fig. 9), retard circulation and prevent fast drying.

When dipping is delayed more than 24 hours after sawing, stain may occur because the chemicals did not penetrate as deep as the fungi, which will continue to grow below the treated surfaces. Furthermore, the chemical is good for only a few months, and subsequent rewetting of the lumber can also produce stain. It is therefore important to stack lumber properly for rapid drying even though it has been promptly dipped.

The cost of dipping varies from 20 to 50 cents per M board-feet of lumber, depending on the dipping equipment and chemicals used. A number of good commercial products for the process are listed in a recent publication.[3/]

Reduction of Warp

It is true that leaning pine trees contain compression wood on the underside of the lean and this abnormal wood warps badly in drying (fig. 10). Little can be done to prevent this type of warp, but fortunately not much of it occurs. Most warp occurs in southern pine as a result of the way it is stacked (fig. 11).

Warp can be controlled by building piles uniformly with an even distribution of weight on all boards. This means firm foundations (fig. 12) with supports under the lumber at 2-foot intervals for 1-inch stock, and 4-foot intervals for thicker stock. All stickers and bolsters should be well-aligned with the foundation timbers and with each other (fig. 13). Stickers and lumber should be uniform in thickness. Piles should be roofed to prevent rainwater and sunshine from contributing to warp in the upper courses. Lumber should be box piled so that no boards extend beyond the pile ends, and stickers should be within 2 inches of the ends of the boards. Stickers should not be more than 2 feet apart for 4/4 lumber or more than 4 feet apart for thicker lumber.

3/ Forest Utilization Service Release No. 10, "The Occurrence and Control of Bluestain in Lumber," available upon request from the Forest Utilization Service, P. O. Box 1183, Macon, Georgia.

Figure 8.--Foundations made of solid cribbing act as barriers to the escape of moisture-laden air from the pile.

Figure 9.--Excessive weeds and lumber in alleys retard drying and harbor decay and bluestain fungi.

Figure 10.--Pine boards containing compression wood often warp badly no matter how the lumber is stacked to dry.

Figure 11.--The result of careless stacking on a pine yard in south Georgia.

Figure 12.--This foundation made of treated timbers permits adequate circulation of air and provides a firm support for the flat piled lumber.

Figure 13.--Boards adjacent to unaligned stickers or bolsters warp badly.

Reduction of End and Surface Checks

Although losses from checking in southern pine lumber constitute a very small part of the total seasoning loss, degrading surface checks and end checks or splits will occasionally develop under conditions extremely favorable to very rapid drying. To prevent this degrade, the operator has recourse to two remedial measures. One is to roof the pile so that constant wetting and drying of the boards in the top courses will be avoided. The second is to place the stickers at the ends of the boards or not more than 2 inches from the ends, thus reducing end drying and largely preventing end checks from extending beyond the stickers.

Measures to Expedite Drying

If is often necessary to dry lumber fast to avoid degrade from blue-stain or to meet customer demand. This can be done in several ways: (1) by stacking in narrow, package piles with ample space between stacks; (2) by crib piling with dry stickers and using enough foundation supports to avoid warping; (3) by using chimneys in flat piles with adequate distance between piles; and (4) by general measures such as more distance between stacks, additional space between individual boards (fig. 14), higher and more open foundations, thicker stickers, and clean, well drained yards that are free from obstructions such as trees and buildings.

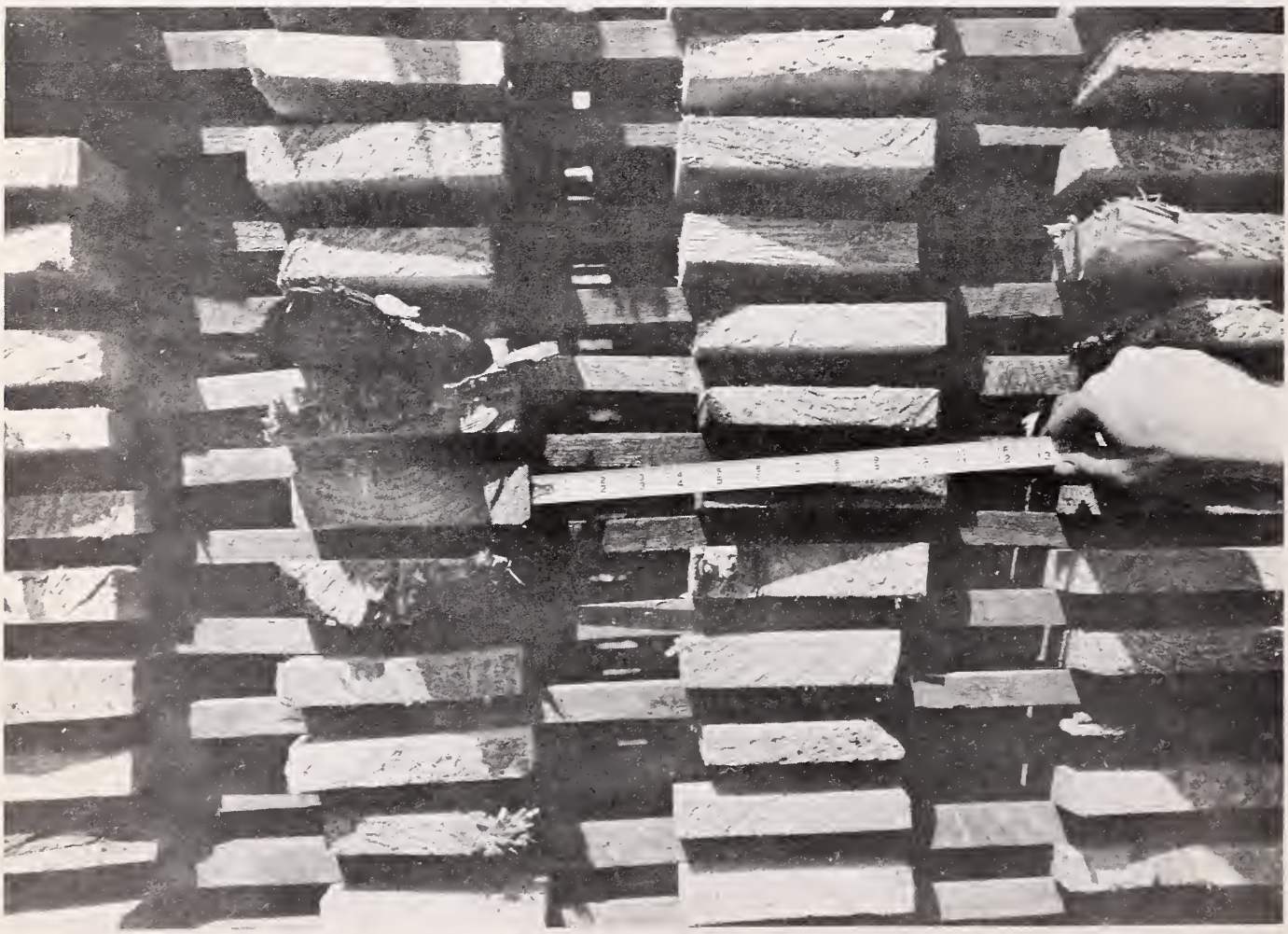

Figure 14.--With adequate spacing between boards, lumber dries faster.

Checklist of Good Seasoning Practices

Each air seasoning yard presents problems peculiar to itself, and the answers to rapid air drying with a minimum of degrade are not necessarily the same for all yards. There are, however, certain fundamental factors that must be considered regardless of location, species, or methods of piling. Included in a list of such factors are the following:

(1) Well-drained and well-aerated yards free of weeds and debris.

(2) Foundations at least 12 and preferably 18 inches high, made of durable material and so constructed that they do not retard the circulation of air throughout the pile (fig. 12).

(3) Rain- and sun-tight covers, particularly over select grades of lumber (fig. 15).

(4) Dry stickers of uniform size placed between courses by means of a sticker guide rack so that they are well aligned (fig. 16).

(5) Spacing of stickers not more than 2 feet apart in 4/4 lumber and 3 feet apart in thicker lumber. End stickers should be within 2 inches of the board ends.

(6) Careful placement of bolsters between the units of a package pile so that they are in line with stickers (fig. 17).

(7) Spacing of individual boards at least an inch apart in flat piles up to 6 feet in width, and construction of flues or chimneys in wide, flat piles.

(8) Rear alleys no less than 4 feet and side alleys no less than 3 feet in width (fig. 18).

(9) Smooth, firm, road surfaces to expedite operation of lumber-handling equipment and to reduce hazards of yard operation.

(10) Dipping in antistain solution before the lumber becomes infected.

The adoption of these practices by concentration yard operators would eliminate much of the unnecessary loss from seasoning degrade not only in Georgia, but wherever lumber is air dried.

Figure 15.--These covers are substantially made of low-grade lumber. They are placed on the top package before this package is lifted in place. Without covers, lumber in the top courses is often degraded.

Figure 16.--This sticker guide rack costs little to make, yet assures alignment of stickers on one side. A portable second side can be added.

Figure 17.--Mechanized yards must be well planned so that lumber-handling equipment can be operated safely and efficiently.

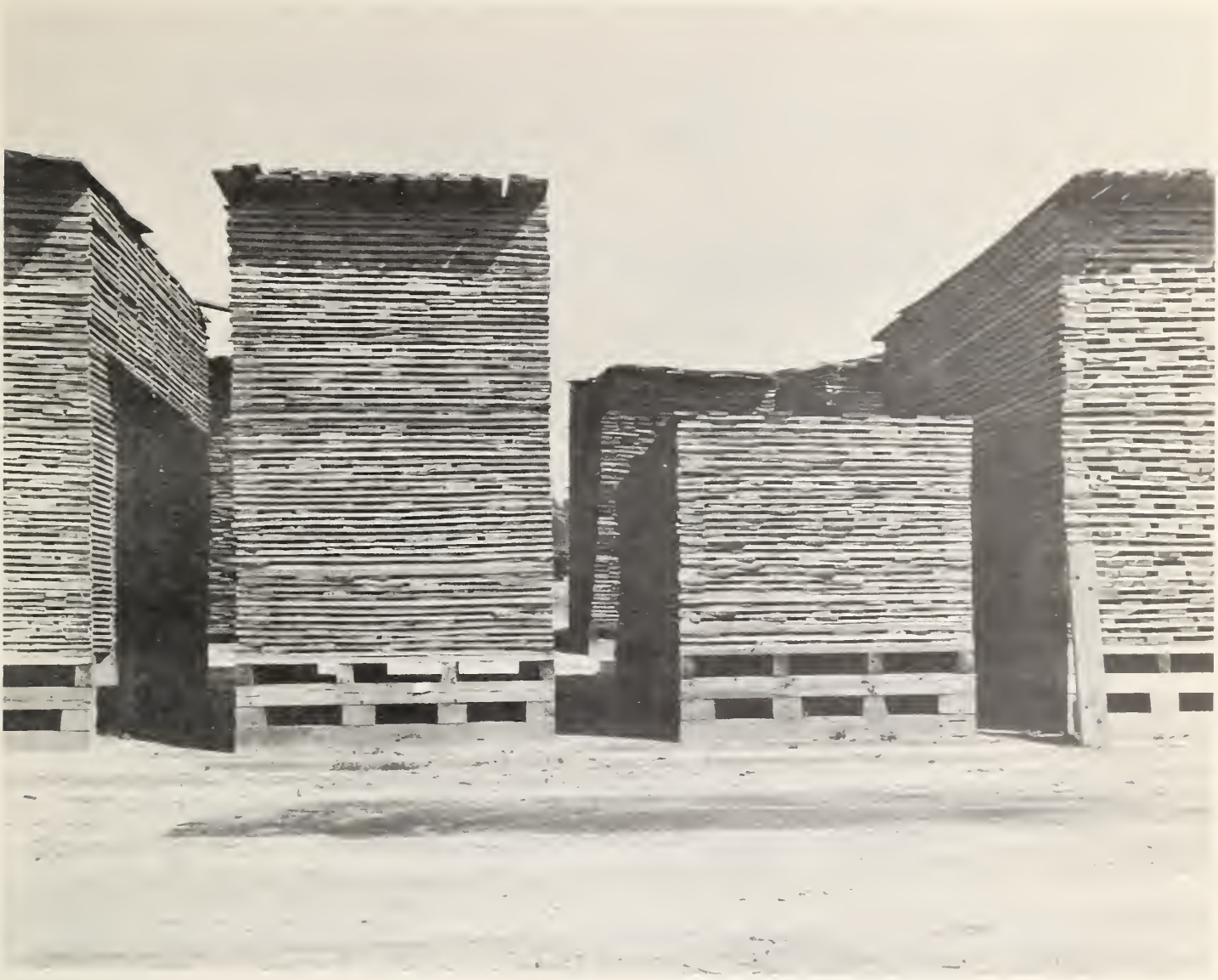

Figure 18.--These well-made stacks of flat piled lumber dry rapidly with a minimum of seasoning degrade.

CONCLUSIONS

Losses from air seasoning mixed grades of 4/4 pine lumber involved in this study in Georgia ranged from $5.21 per M board-feet for package piled to $26.21 per M board-feet for flat piled lumber. These losses are sufficiently serious in most yards to justify remedial measures.

With proper practices, it should be possible to eliminate most of these losses and thus effect an appreciable savings to the lumber yard owners in the state. This potential added income from better seasoning practices would offset, in part at least, the recent increase in labor cost and the steadily rising cost of stumpage. In fact, the money saved by adopting improved practices in air seasoning lumber might well be the major factor in determining whether or not many Georgia mills continue to operate.

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